Intelligent structural design of shear wall residence using physics■enhanced generative adversarial networks

Year: 2022 | Citations: 109 | Authors: Xinzheng Lu, Wenjie Liao, Yu Zhang, Yuli Huang

Abstract

Intelligent structural design using generative adversarial networks (GANs) is a revolutionary design approach for building structures. Despite its far■reaching capability, the data quantity and quality may have limited the performance of such a data■driven network. This study proposes to enhance the objectiveness of training processes by innovatively introducing a surrogate model, Physics Estimator, that informs the generator by appraising the physical behavior of the generated design. Dual loss functions evaluated by a traditional data■driven discriminator and the Physics Estimator collaboratively foster the physics■enhanced GAN architecture. We further develop a structural mechanics model to train and optimize the inherent accuracy of the Physics Estimator. The comparative study suggests that the proposed physics■enhanced GAN can generate structural designs from architectural drawings and specified design conditions 44% better than a data■driven design method and 90 times faster than a competent engineer.